The bulk-rock geochemistry of the 3.45 Ga Marble Bar Chert (ABDP#1 site)

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Major, trace and rare earth element abundances were determined on 123 drill core samples of the Marble Bar Chert from the ABDP #1 site. Since Kato & Nakamura (2003) already reported geochemical data on outcrop samples of the Marble Bar Chert, we are able to evaluate the extents of modern weathering and three-dimensional variations in rock chemistry. The Fe2O3* contents of the core samples vary, but are generally low (0.02-10.2 wt%; average = 2.05 wt%). Their Eu anomaly values (Eu/Eu*) range from 0.84 to 2.72 (avg = 1.51), exhibiting weak positive Eu anomalies except for several samples. The Ce anomaly values (Ce/Ce*) narrowly range from 0.80 to 1.29, indicating most core samples lack Ce anomalies. However, some samples exhibit weak negative Ce anomalies. In contrast, the surface chert samples are characterized by: (1) much higher Fe2O3* contents (up to 39.6 wt%, avg = 10.7 wt%); (2) stronger positive Eu anomalies (Eu/Eu* =1.31-6.61, avg = 2.61); and (3) distinct negative Ce anomalies (Ce/Ce* = 0.60-1.04, avg = 0.86).

The differences in bulk-rock geochemistry between the subsurface and surface samples probably reflect the primary differences in chert chemistry, rather than the effects of modern weathering. The ABDP#1 site is located several kilometres from the surface sample site. The surface chert samples with higher Fe2O3* contents and distinct positive Eu anomalies probably deposited from high temperature hydrothermal solutions emanating from a mid-oceanic ridge (MOR), while the cherts at the drilling site deposited from low temperature hydrothermal fluids. The observed relationships among (a) the magnitudes of positive Eu anomalies, (b) the magnitudes of negative Ce anomalies and (c) the Fe/Si ratios of Fe-rich sediments, and (d) the distance from the center of hydrothermal discharge zone for the 3.45 Ga Marble Bar cherts are essentially the same as those of modern MOR sediments.